Impacts of Anthropogenic Change on the Ecology of Human Pathogens in a Eutrophying Estuary: The Neuse River Estuary

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Approximately 75% of people in the U.S. live in coastal watersheds, with coastal urbanization and agricultural and industrial development increasing at rapid rates. Accelerating nutrient- and pathogen-enriched wastewater discharges accompanying coastal development are putting unprecedented pressure on estuaries that receive and process the bulk of land-based runoff from all sources. Enhanced nutrient loading has led to increased primary productivity or eutrophication, the consequences of which pose a significant threat to coastal resources and ecological health. This eutrophication leads to organic matter enrichment of affected waters. Most human pathogens in wastewater discharges are heterotrophs and may thrive under these enriched organic matter conditions. As a result, pathogen populations may increase under increased nutrient loading, as will human exposures and health effects.

This research focuses on understanding the relationships between nutrient loading in an important watershed (the Neuse River Estuary), growth and fate of microorganisms linked to infectious disease, and subsequent impacts on human health. The long-term goal is the creation of a computational model useful in estimating the effect of watershed protection policies on ecological and human health. The research is founded on a conceptual framework derived from human health risk assessment and uses data collected within that framework to focus on more fundamental scientific research in a way that ensures optimal reduction of uncertainties in current understanding of the links described above. The research focuses on microorganisms that are of great significance to human health and representative of the more general class of infectious disease agents whose fate is governed by environmental conditions in estuaries.

A particularly important aspect of this research is that it uses an interdisciplinary approach by bringing together investigators from different organizations studying estuarine dynamics, pathogen ecology, and human health risk. The modeling framework combines experimental and field information to examine underlying mechanisms, environmental controls, and trophic interactions in a well-characterized estuary experiencing advanced symptoms of eutrophication. This framework causes enhanced interactions between experimentalists and modelers, ensuring that the two groups function as a single research unit.